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Categorization of ICMR Using Feature Extraction Strategy And MIR With Ensemble Learning

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Abstract

The Indian classical music and the raga's studied in this research paper. This paper focuses on categorization of these ragas into various different categories based on their features extracted. The tools like PRAAT, MIRchromagram and WEKA have been used for the simulation. The results proved the efficiency increased to 89%.This paper includes the ensemble approach that is used to categorize the Indian classical raga's based on their different characteristics. This paper also shows the comparison of different models as well so as to measure the percent changes in their performance.

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Keywords: MIR(Music Information retrieval); Chromagram; onsets; Raga; classification.

1. Introduction

The music information retrieval tasks considered as main focus. While doing the categorization of various raga, the Indian classical music subdivided using these raga into different classes. The ancient raga artists and performers created groups of different ragas based on the time zones (also known as *Prahar's*). The ragas when recited according to the time group, it would have maximum impact on the sentiments or the mood of the peoples.

The new learners in the music field find it very difficult to identify the *raga* from any musical excerpts when played. Hence there is a necessity of quick identification of the associated *raga*. This paper presents the

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approach of ensemble learning for the different *ragas*. The combination of various learners provides the possibility to create and comparison parametric evaluation and enhances the accuracy in real sense. The ICMR *(Indian Classical Music Raga)* is the grouping of the various *raga* that can be classified in to different *thaats* and hence it could be easy to further categorize them in to the various *ragas*.

1.1. *Basic Raga Structure:* The *Raga* [1] follows the structure with the pitch class representation; which can be described by the frequency estimates on each key. Hence when the key are displayed on any musical instrument are pressed and played with the desired interval and sequence it produces the *raga.* In the Hindi scales include the *Sa* from first black key/note. But in the western scales [2] the *Sa* resembles to the Key C. and fifth note from C is fifth note. In the western note the C doesn't changes. Only the scales show the pitch changes. In the western notes there is an absolute naming for the keys in each and every octave on the keyboard or frets on guitar. But there is a difference that in Indian scheme the notations are relative.

The *desi* music combines the both of Indian as well as Western styles. The music structure includes the scale on seven note or the seven note scale, in which the second, third, fourth , sixth, and seventh notes can be treated as sharp or flat. In Indian music there is no absolute pitch, but instead each performance is simply pics the ground note; this ground note would be treated as a fundamental frequency. And the other scale degrees follow relative to the ground/fundamental frequency note. Where, the scale is the set of 7 Notes with predefined intervals. So when starting from the F note we could still form the *Sa, Re, Ga, Ma, Pa, Dha, Ni* from that note. The interval is the distance between the notes. Hence it can be concluded that the scales and the raga are not the same. And the scale is the predefined interval of the seven notes.

2. Literature Survey:

The *raga* can have 4 or more notes with the intervals. Some of the findings are also reluctant to say that western music is fast and the Indian music is totally based on the formation of these seven or less key combinations and thus it is melodic. And the western music is basically *harmonic* in nature, and uses chords to produce the harmony. The literature survey includes all the recent studies in this field. As anyone can see the MIR is very interesting and emerging field for those who have knowledge in this field. The music professionals are facing the challenges related to this field as they saw the musical data is very difficult to categorized in any of the class based on the musical characteristics like *raga* , genre, artist, sentiments, mood, feelings etc. to name a few.

The Nomenclature of the raga		
Tiver or *Sharp* (Black keys)	Capital letters	R, G, M, D, N
Komal or *Flat* (White keys)	Small letters	r, g, m, d, n
C further nomenclature continues down the page inside the text box		

The following fig. 1 shows the instrument harmonium for the key distribution on it, according to octave.

Fig. 1: Nomenclature on instrument (Indian Harmonium).

2.1. Identification of the raga from any musical excerpts individually:

The ragas can be identified by analyzing *Pakad* and *Bandish* and getting the most dominant notes of a given raga. Each of the raga has its own *bandish*. The *varjit swara* is very restricted and need to be taken care of and excluded while rendering the raga (It has also been considered as an enemy of raga, and restricted for a given raga). There is a very favorable thing that to understand the bandish of raga it has to be listen carefully or needs to practiced on any instrument and know the keys/notes. Other better technique is to listening it from a far distance and tries to judge the notes played by the performer or notes rendered on instruments. So, in this practice listener will hear the dominating notes / bandish only and the raga could be predicted by the listener. It is a individual based technique. There is a need to just remember that the raga identification begins with the identification of notes.

This paper focuses and considered all these challenges to conquer over, and tried to find the best possible answer/solution to these problems. The recent challenges adapted the *raga* classification and clustering very difficult and impossible to predict when considered as a large set.

The study done by *parag chordia* was based on the application of the sound flower and max software based analysis, in which researcher tried to create application and compare the *raga* separately [6].

The *HMM* [3] technique is used in the current research for the musical analysis. This technique shows the HMM details and the markov relation property in order to get the structural representation [4] to be matched with the markov chains [7][8].

The fig. 1 shows the typical Hindustani instrument named as Harmonium. This instrument is used for many decades in the musical accompaniment. Any performer can match the fundamental C-note frequency and from this frequency he/she can give their performance with the accompaniment on this instrument.

3. Proposed Approach:

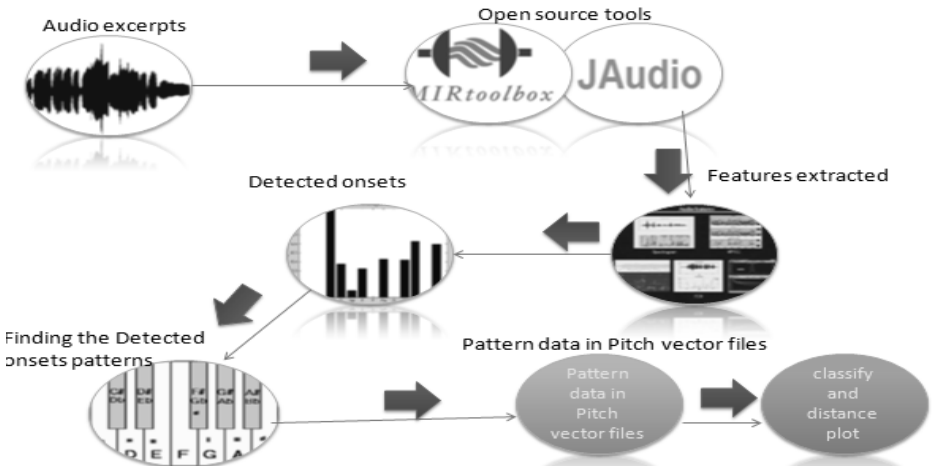

Fig. 2: The proposed approach.

In this approach the audio excerpt portion is utilized for digital signal processing (the tools used for this are Jaudio and MIR toolbox) in which the signal is analyzed and features extracted and used for detection of the onsets. Just after the detection of the onsets it can be used to identify the patterns of the signals. When the patterns studied and analyzed and compared with the raga data set and match with their pitch vector file records its concluded to say that what characteristics of raga it posses. The classification is done based on the patterns obtained of the various ragas.

4. Algorithm Steps:

Step 1: For our problem, we consider the sample raga data set as input vector of data set X[n].

Step 2: Extract the features from it by applying the feature extraction methods in the frequency domain. It includes the Fourier transform for all the n- samples of raga data set.

Step 3: Now compute the pitch class profiles and the spectrum based on the frequency spectra. The PCP computation needs to be taken thoroughly for the overall calculation.

Step 4: Use the SOM [11] technique on the identified set of PCP details.

Step 5: Obtain the values which are based on the SOM results

Step 6: Use the different values like changing the speed, frequency etc., then notice the changes.

Step 7: Since the raga data having the values that are varying nature using the SOM and finding the nearest neighbors in it, enable us to find the clusters of much related raga data.

Step 8: The clusters that are formed using SOM utilizes the KNN and the nearest neighbor analysis.

Step 9: The raga data is now clustered according to the nature of the raga.
Step 10: Display the result data

As per the algorithmic steps, the sample data of raga is collected and used as input vector. Then first the features needed to be extracted. It involves all the methods of digital signal processing. The fast Fourier transform calculated by digital signal processing techniques. The pitch class profiles extracted and spectrum can be plotted. And the computation can be done. With the help of SOM (Self organized maps) [12] techniques the raga that is most relevant can be identified.

In the Fig 3. raga cluster formation technique includes the KNN [9] [14]and SOM approach which is the best suited.

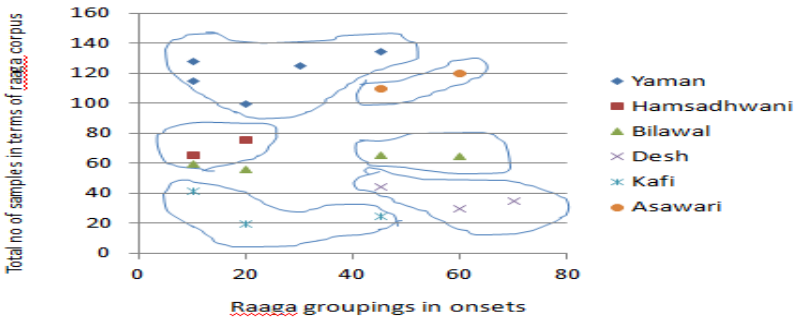

Fig. 3: Cluster formation of various raga based on profiles of pitches.

5. Results and discussion:

Sno	J48	Naïve Bayes	JRip
1	53.6	52	51.0
2.	46.3	35.52	32.8
3.	51.4	43.46	40.6
4.	50.2	47.24	44.2
5.	51.0	41.5	40.7
Average Accuracy	50.5%	43.94%	41.86%

Fig. 4: (a) Classification Accuracy For Ensemble.

Sno	SOM Self Organized map	EM	K Means
1.	57.5	55.2	54.3
2.	55.6	54.5	53.6
3.	54.9	53.8	52.7
4.	58.2	55.1	51.3
Average Accuracy	56.55%	54.65%	52.98%

Fig. 4: (b) Cluster Accuracy For Ensemble. .

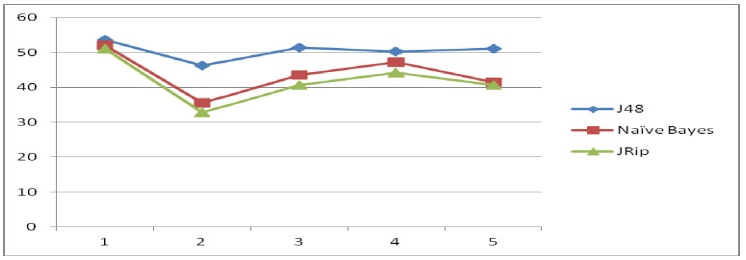

Fig 4: (c) Classification Accuracy data chart

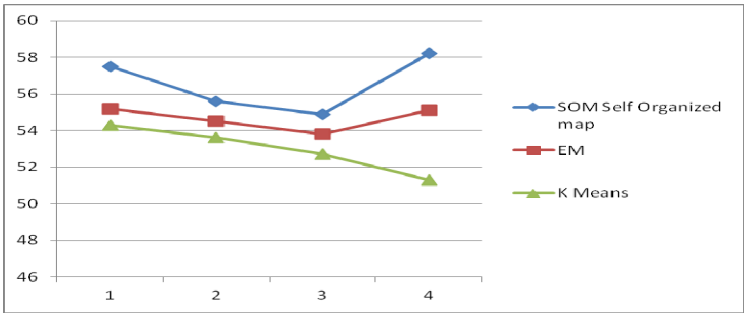

Fig 4: (d) Clustering Accuracy data chart

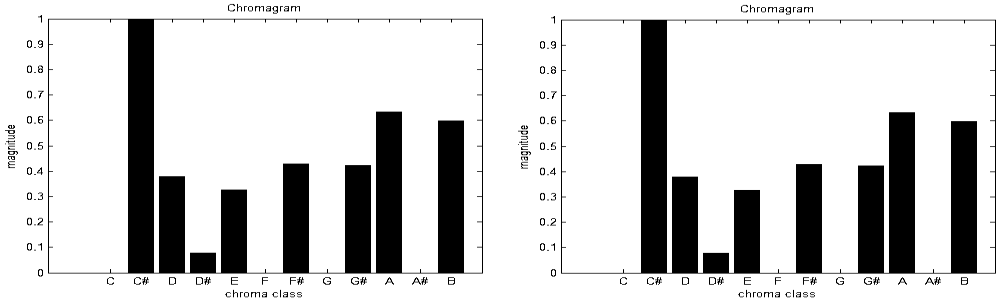

Fig. 5: (a) Classification of detected onsets; (b) Pitch classes of the various raga using MIR.

In the fig. 4 (a) and (b) we compared the classification and clustering approaches and used ensemble learner for these and after analysis an these data the charts plot had been formed which shows the accuracy. And the results obtained shows the accuracy been raised in SOM and J48 to be maximum in the results. This concludes our research in the simulation step.

The Detailed accuracy charts had been analyzed in fig. 5(a) and fig. 5(b) for onsets and pitch classes simultaneously.

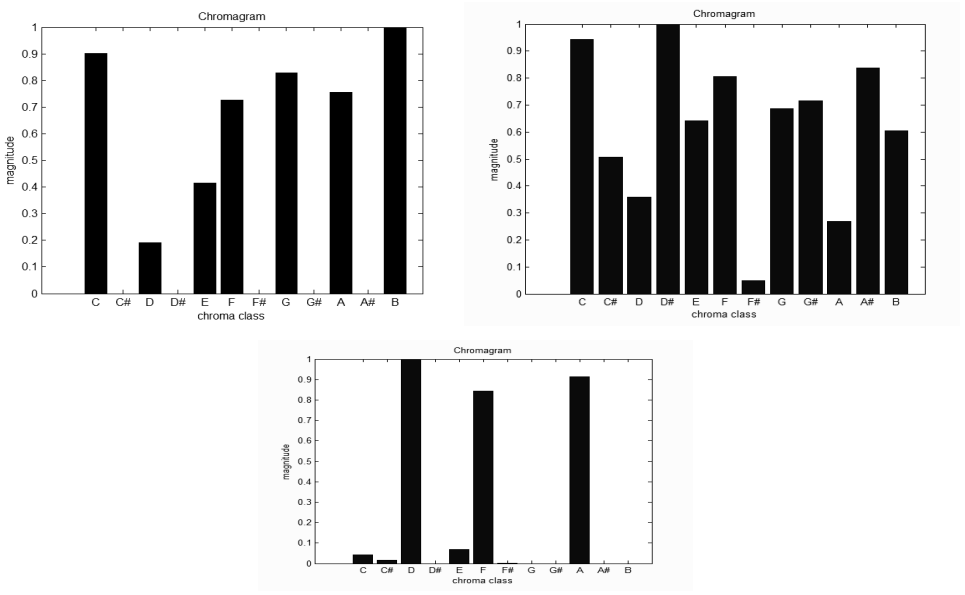

Fig. 6: Classification of detected onsets

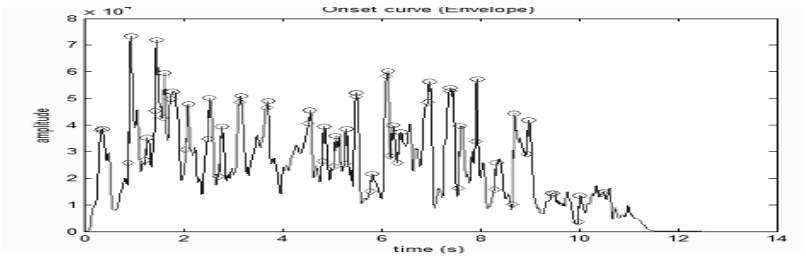

Fig.7: Pitch estimates of the various raga using MIR.

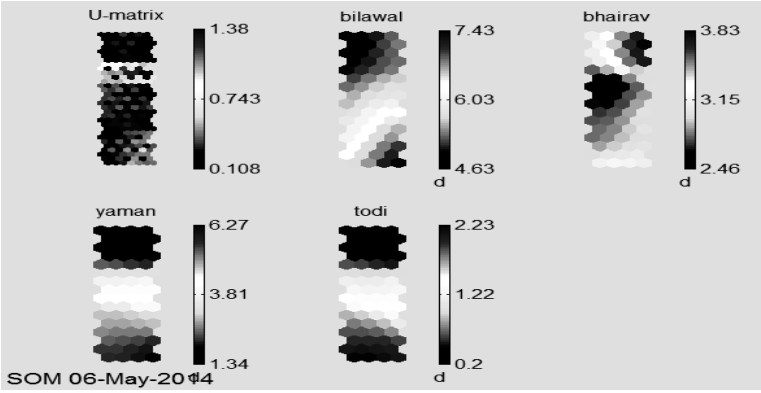

Fig. 8: Classification of different raga cluster of detected onsets

According to the fig the onsets that have been plotted based on the frequencies of the targeted audio excerpts and the song files, the various raga can be categorized. The categorization is highly optimized and accurate. In this paper, the ensemble learner is used.

5.1. Table with details of comparative result of different models:

Accuracy levels in different cases	Classification	Clustering
Model 1	78%	67%
Model 2	88%	80%
Model 3	91%	89%
Model 4	93%	77%
Model 5	80%	72%
Model 6	75%	72&
Model 7	90%	82%
Model 8	72%	83%
Model 9	70%	66%

6. Conclusion and future scope

In this research paper the ensemble learner is used and this devised mechanism is capable enough to compare the various results and models on the basis of their performance. The result variation shows the percentage improvement in the performance by just focusing on the characteristics. The raga study is of prime importance to the music professionals and once they are capable to categorize the songs as per their characteristics the research time devoted in these improvisation and discovery of new ragas can be increased in no time. As the need to devote the time in finding the new ragas should be highly rewarding, but it comes ones the new learners find less time in categorizing raga to learn them fast. The new categorization algorithm are of huge demand these days so as to increase the power of categorization in raga study. Some of them are HMM

based and KNN based and while just providing learning more algorithms can also be put together to frame a high performance criterian.

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